Novel Crack Stopper Concept for Lightweight Foam Cored Sandwich Structures – Experimental Validation, Fe-Modelling and Potential for Use in Structures

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NOVEL CRACK STOPPER CONCEPT FOR LIGHTWEIGHT FOAM CORED SANDWICH STRUCTURES – EXPERIMENTAL VALIDATION, FE-MODELLING AND POTENTIAL FOR USE IN STRUCTURES

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ABSTRACT

A novel crack arresting device has been implemented in foam cored composite sandwich beams panels and tested under both static and fatigue loading conditions. Fatigue crack propagation was induced in the face-core interface of the sandwich panels which met the crack arrester. The effect of the embedded crack arresters was evaluated in terms of the achieved enhancement of the damage tolerance of the tested sandwich beams and panels. Finite element (FE) modelling of the experimental setups was used for predicting propagation rates and direction of the crack growth. The FE model predicts the energy release rate and the mode mixity based on the derived crack surface displacements, utilizing algorithms for the prediction of accelerated fatigue crack growth as well as the strain field evolution in the vicinity of the crack tip on the surface of the sandwich specimens. Finally, a comparison between the experimental results and the numerical simulations has been made to validate the numerical predictions as well as the overall performance of the crack arresters. Based on a linear elastic fracture mechanics approach, the developed FE model was utilized to simulate crack propagation and arrest in foam cored sandwich beam and panel specimens subjected to fatigue loading conditions. The effect of the crack arresters on the fatigue life is analysed, and the predictive results are subsequently compared with the observations from fatigue tests. Overall it was demonstrated that the proposed crack arrester device was indeed capable of deflecting and arresting propagating face-sheet/core interface cracks, and further that the use of embedded crack stoppers is capable of extending the fatigue life very significantly. It was further demonstrated that the developed numerical analysis procedures provide predictions that are in excellent agreement with the experimental observations.

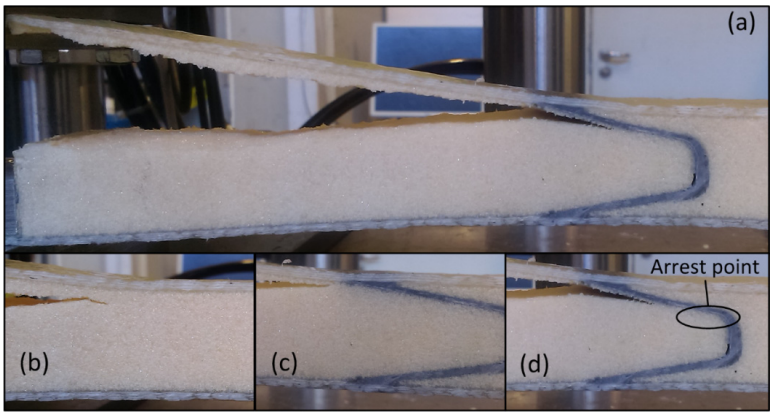

Figure 1: Crack stopper embedded in GFRP/foam core sandwich panel.

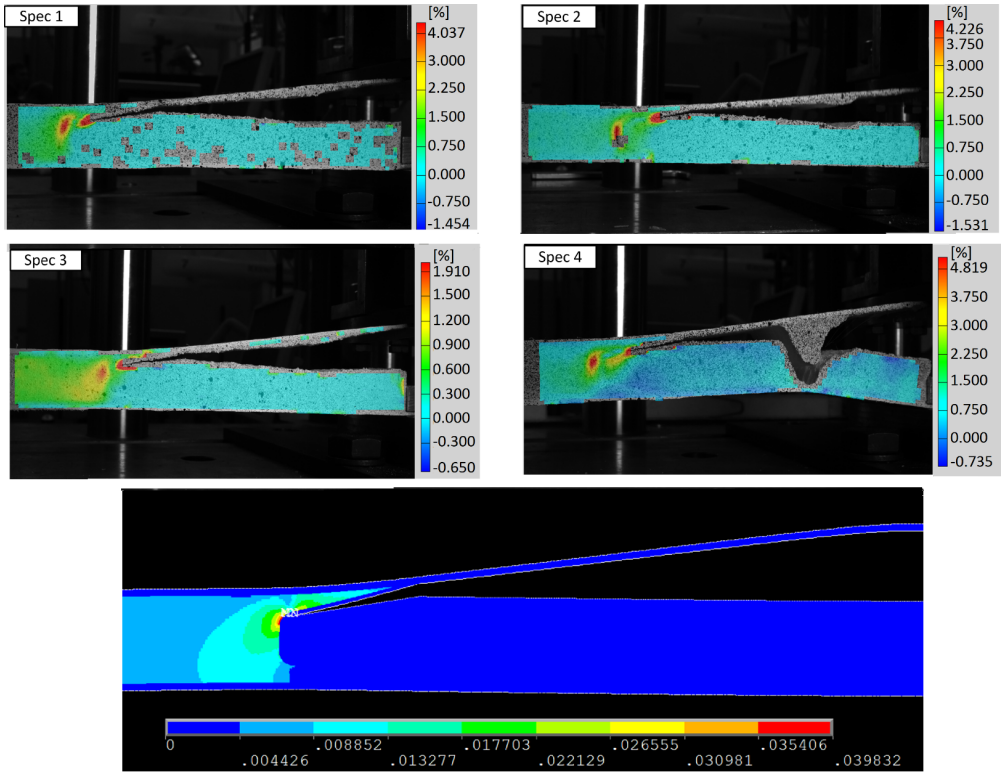

Figure 2: DIC measurements vs. FE analysis results at crack arrest.

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[3] Martakos, G., Andreasen, J.H., Berggreen, C., Thomsen, O.T., 2016, Experimental Investigation of Interfacial Crack Arrest in Sandwich Beams Subjected to Fatigue Loading using a Novel Crack Arresting Device. *Journal of Sandwich Structures and Materials*. Accepted for publication, 2016.